

1 – 6 (Deleted)

7. (Currently Amended) A method of fabricating a semiconductor Insulated-Gate Field-Effect Transistor (Gated-FET), comprising:

depositing a semiconductor thin film layer on a thick insulator; and

forming a substantially rectangular channel region in said semiconductor thin film layer, said

channel region lightly doped to form a resistive channel, wherein the height of the

channel region comprising the entire thin film thickness; and

depositing a gate insulator layer above said channel region; and

depositing a gate material above said gate insulator layer, said material forming a gate region
above said channel region;

wherein optimizing said thin film properties, gate insulator properties and gate material
properties such that said gate region further comprises:

a first voltage level that modulates said channel resistance to a substantially non-
conductive state by fully depleting majority carriers from said channel region; and

a second voltage level that modulates said channel resistance to a substantially
conductive state by at least partially accumulating majority carriers near the gate
insulator surface in said channel region; and

~~The method of claim 1,~~ wherein depositing said semiconductor thin film layer further comprises:

defining a surface voltage as $\Phi_S = V_D - V_{FB} - T_G \cdot Q_S / \epsilon_G$; and

defining a surface dopant level as $N_S = D \cdot \exp(q\Phi_S/kT)$; and

defining a first thickness as $L_D = [\epsilon_S \cdot kT / (q^2 N_S)]^{0.5}$; and

defining a second thickness as $X_A = \sqrt{2} \cdot L_D \cdot [(N_S/D)^{0.5} - 1]$; and

defining a surface charge as $Q_S = q \cdot N_S \cdot X_A / (1 + X_A / (\sqrt{2} \cdot L_D))$; and

iteratively identifying the consistent set of values that satisfies said definitions; and

depositing a substantially uniform thickness T_S of said semiconductor thin film layer,

wherein said thickness T_S is greater than said second thickness X_A ;

where, V_D is power supply voltage level, ϵ_S is channel semiconductor permittivity, ϵ_G is gate insulator permittivity, T_G is gate insulator thickness, V_{FB} is gate material to semiconductor channel absolute flat band voltage, k is the Boltzmann's constant, T is the absolute temperature, q is electron charge and D is channel region doping level.

8. (Currently amended) The method of claim 7 ~~claim 1~~, wherein depositing said semiconductor thin film layer further comprises:

defining a ~~first~~ third thickness as $X = \epsilon_S \cdot T_G / \epsilon_G$; and

defining a ~~second~~ fourth thickness as $Y = [(2 \cdot \epsilon_S \cdot (V_{FB} - V_T)) / (q \cdot D)]^{0.5}$; and

defining a ~~third~~ fifth thickness as $Z = (X^2 + Y^2)^{0.5} - X$; and

depositing ((a)) said substantially uniform thickness T_S of said semiconductor thin film layer,

wherein said thickness T_S satisfies a thickness range approximately $0.8 \cdot Z$ to $1.2 \cdot Z$;

where, ϵ_S is channel semiconductor permittivity, ϵ_G is gate insulator permittivity, T_G is gate insulator thickness, V_{FB} is gate material to semiconductor channel absolute flat band voltage, V_T is channel region absolute threshold voltage, q is electron charge and D is channel region doping level.

9. (Currently amended) The method of claim 7 ~~claim 1~~, wherein said gate insulator material

comprises an oxide, said gate material comprises a heavily doped poly Silicon material with opposite type dopant to said channel region, and depositing said semiconductor thin film layer further comprises:

defining a ~~first~~ third thickness as $X = 3 \cdot T_{OX}$ (Angstroms) ; and

defining a ~~second~~ fourth thickness as $Y = 0.28/\sqrt{D}$ (Angstroms) ; and

defining a ~~third~~ fifth thickness as $Z = (X^2 + Y^2)^{0.5} - X$ (Angstroms) ; and

depositing ((a)) said substantially uniform thickness T_S of said semiconductor thin film layer,

wherein said thickness T_S further satisfies a thickness range approximately $0.8 \cdot Z$ to

$1.2 \cdot Z$;

where, T_{OX} is gate oxide thickness in Angstroms, D is channel doping level in atoms/(Angstroms)³ and T_S is channel semiconductor layer thickness in Angstroms.

10. (Currently amended) The method of claim 7 ~~claim 1~~, comprised of forming one of N channel or P channel Gated-FET thin film transistor consisting a process sequence comprised of:

depositing one of amorphous or crystalline poly-1 (P1);

performing P1 mask & etching P1;

applying blanket Gated-NFET V_T N- implant;

applying Gated-PFET V_T mask & P- implant;

depositing Gox;

depositing one of amorphous or crystalline poly-2 (P2);

applying blanket P+ implantation of Gated-NFET Gate;

applying N+ mask & implanting Gated-PFET Gate;

applying P2 mask & etching P2;

applying blanket LDN N implant (Gated-NFET LDD);
applying LDP mask & P implant (Gated-PFET LDD);
depositing a spacer oxide and etching the spacer oxide;
depositing Nickel;
salicidizing the Nickel on exposed P1 and P2;
salicidizing P1 completely;
performing RTA anneal, P1 and P2 re-crystallization and dopant anneal;
depositing ILD oxide & CMP;
applying C2 mask & etch;
forming a W plug & CMP; and
depositing M1.

11. (Currently amended) The method of claim 7 ~~claim 1~~, comprised of forming one of N channel or P channel thinned down SOI Gated-FET thin film transistor consisting a process sequence comprised of:

forming SOI substrate wafer;
performing Shallow Trench isolation: Trench Etch, Trench Fill and CMP;
depositing Sacrificial oxide;
applying Periphery PMOS V_T mask & implant;
applying Periphery NMOS V_T mask & implant;
applying Gated-FET mask and Silicon etch;
performing Gated-FET blanket V_T N implant;
applying Gated-FET V_T P mask and P implant;

performing Dopant activation and anneal;
performing Sacrificial oxide etch;
depositing Gate oxide / Dual gate oxide option;
depositing Gate poly (GP);
applying Gated-FET N+ mask and N+ implant;
applying Gated-FET P+ mask and P+ implant;
applying GP mask & etch;
applying LDN mask & N- implant;
applying LDP mask & P- implant;
depositing Spacer oxide & spacer etch;
applying Periphery N+ mask and N+ implant;
applying Periphery P+ mask and P+ implant;
depositing Ni;
performing RTA anneal - Ni salicidation (S/D/G regions & interconnect);
performing Dopant activation;
performing Unreacted Ni etch;
depositing ILD oxide & CMP; and
applying contact mask and etch.

12. (Currently amended) The method of claim 7, comprising forming a source region and a drain region on opposite sides of said substantially rectangular channel region in said semiconductor thin film layer, further comprised of:
doping said source region to a higher level than said channel region, said dopant type same as

said channel region; and
doping said drain region to a higher level than said channel region, said dopant type same as said
channel region; and
providing a conducting path from said source region to said drain region through said resistive
channel region in the middle, said conducting path comprising the entire thickness of the
thin film layer;

~~The method of claim 6,~~ wherein the absolute value of said channel region threshold voltage V_T comprises a value in the range from 0.10 to 0.40 times a system power voltage level, and preferably in the range 0.15 to 0.30 times a system power voltage level, and more preferably in the range 0.18 to 0.22 times a system power voltage level.

13. (Deleted)

14. (Currently amended) A method of fabricating a semiconductor N channel Gated-FET transistor, comprising:
depositing a semiconductor thin film layer on a thick insulator; and
forming a substantially rectangular channel region in said semiconductor thin film layer, said
channel region lightly doped with N type dopant to form a resistive channel, wherein the
height of the channel region comprising the entire thin film thickness; and
forming a source region and a drain region on opposite sides of said rectangular channel region
in said semiconductor thin film layer, said source and drain regions heavily doped with N
type dopant; and
depositing a gate insulator layer above said channel region; and

depositing a heavily P type doped poly-silicon gate material above said gate insulator layer, said gate material forming a gate region above said channel region; and
optimizing said thin film properties, gate insulator properties and gate material properties such that said gate region further comprises:
a first voltage level that modulates said channel resistance to a substantially non-conductive state by fully depleting majority carriers from said channel region, said state disconnecting said source from said drain region; and
a second voltage level that modulates said channel resistance to a substantially conductive state by at least partially accumulating majority carriers near the gate insulator surface of said channel region, said state connecting said source to said drain region;

~~The method of claim 13~~, wherein said first voltage level comprises a voltage in the range from system ground voltage level to a threshold voltage level, wherein:

said thin film channel is fully depleted of majority carriers; and
said source region is decoupled from said drain region for a drain to source differential bias voltage ranging from zero to a system power supply voltage.

15. (Currently amended) The method of claim 14 ~~claim 13~~, wherein said second voltage level comprises a voltage in the range from said threshold voltage level to a flat band voltage level, wherein:

said thin film channel is not fully depleted, said channel comprising majority carriers; and
said source region is coupled to said drain region for a differential bias voltage ranging from zero to a system power supply voltage.

16. (Currently amended) The method of claim 14 ~~claim 13~~, wherein said second voltage level comprises a voltage in the range from said flat band voltage level to a system power voltage level, wherein:

said thin film channel majority carrier concentration is substantially enhanced above said channel doping level by an accumulation near the gate insulator surface; and

said source region is coupled to said drain region for a differential bias voltage ranging from zero to a system power supply voltage.

17. (Deleted)

18. (Currently amended) A method of fabricating a semiconductor P-channel Gated-FET transistor, comprising:

depositing a semiconductor thin film layer on a thick insulator; and

forming a substantially rectangular channel region in said semiconductor thin film layer, said channel region lightly doped with P type dopant to form a resistive channel, wherein the height of the channel region comprising the entire thin film thickness; and

forming a source region and a drain region on opposite sides of said rectangular channel region in said semiconductor thin film layer, said source and drain regions heavily doped with P type dopant; and

depositing a gate insulator layer above said channel region; and

depositing a heavily N type doped poly-silicon gate material above said gate insulator layer, said gate material forming a gate region above said channel region; and

optimizing said thin film properties, gate insulator properties and gate material properties such that said gate region further comprises:

a first voltage level that modulates said channel resistance to a substantially non-conductive state by fully depleting majority carriers from said channel region, said state disconnecting said source from said drain region; and

a second voltage level that modulates said channel resistance to a substantially conductive state by at least partially accumulating majority carriers near the gate insulator surface of said channel region, said state connecting said source to said drain region;

~~The method of claim 17~~, wherein said first voltage level comprises a voltage in the range from a system power voltage level to a threshold voltage below system power voltage level, wherein:

said thin film channel is fully depleted of majority carriers; and

said source region is decoupled from said drain region for a source to drain differential bias voltage ranging from zero to said system power supply voltage.

19. (Currently amended) The method of claim 18 ~~claim 17~~, wherein said second voltage level comprises a voltage in the range from a flat band voltage level below system power voltage level to said threshold voltage below system power voltage level, wherein:

said thin film channel is not fully depleted, said channel comprising majority carriers; and

said source region is coupled to said drain region for a differential bias voltage ranging from zero to said system power supply voltage.

20. (Currently amended) The method of claim 18 ~~claim 17~~, wherein said second voltage level

comprises a voltage range from a system ground voltage level to said flat band voltage level below system power voltage level, wherein:

said thin film channel majority carrier concentration is substantially enhanced above said channel

doping level by an accumulation near the gate insulator surface; and

said source region is coupled to said drain region for a differential bias voltage ranging from zero

to said system power supply voltage.